ADRIATIC, BLACK SEA: THE WHITING DOUBT

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ABSTRACT. - This paper presents metric and meristic data relative to two groups of samples of whiting collected in the Adriatic and the Black Sea. The same data, after simple statistical and multivariate analysis, show a morphological differentiation between the populations of the two basins.

RÉSUMÉ. - Quelques données métriques et méristiques relatives à deux groupes différents de merlans capturés en Adriatique et en Mer Noire ont été relevées. Ces mêmes données, soumises à analyses statistiques simples et multivariées, ont mis en évidence une différence morphologique entre les deux populations.

Key-words. - Gadidae, *Merlangius merlangus*, MED, Adriatic, Black Sea, Biometry.

The whiting, *Merlangius merlangus* (L.), a gadoid of medium size (max. length 60-70 cm, in the Atlantic Ocean), is mainly distributed in the North-East Atlantic, the North Sea, the northern areas of the Mediterranean basin, including the north of the Adriatic and Aegean Seas, and the Black Sea (Svetovidov, 1986). The distribution of the whiting in the Mediterranean basin often gives rise to debate as to the eventual differentiation of two subspecies: *M. merlangus merlangus* (L.) and *M. merlangus euxinus* (Nordmann).

Ichthyologists have been confronted with some metric and meristic differences, as well as in the areas in which the subspecies are found. More specifically, in reference to recent work on the subject, Bini (1970) distinguished between the *M. m. merlangus* of the Adriatic and the *M. m. euxinus* of the Black Sea, on the basis of the respective absence (or microscopic nature) or presence of a barbel (visible to the naked eye), and on some measurable and meristic features (number of fin rays).

Tortonese (1970), based on the same analysis, attributed both populations to the subspecies *M. m. euxinus*, noting, however, that the determination required further confirmation. Soljan (1975) took note of the doubts on the subject, by including both forms in his key to the classification of the fish of the Adriatic, a line also taken by Giovanardi and Rizzoli (1984). Finally, Svetovidov (1986) and Bauchot (1987) consider only the subspecies *M. m. euxinus* for both the Mediterranean and the Black Sea.

This paper represents a contribution to the attempt to resolve this problem.

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MATERIALS AND METHODS

Comparative studies were carried out on 33 specimens collected in the Adriatic (Fano) and 15 specimens from the Black Sea (Cayglou). The metric measurements taken in mm are shown in figure 1. The standard length of the fish varied from 119 to 160 mm in the Black Sea and 120 to 213 mm in the Adriatic. The meristic characteristics considered were the presence of a visible barbel and the number of rays in the three dorsal fins (NR1D, NR2D, NR3D) and the two anal (NR1A, NR2A). Later on the metric data (% SL) are elaborated, calculating some statistics and then applying multivariate analysis. Such classification techniques can in some cases be useful in the determination of subspecies or species of teleosteans (Mistri and Colombo, 1990; Gourene and Teugels, 1993), and in particular in this study it has proved useful to use the principal components analysis (PCA; software STATITCF).

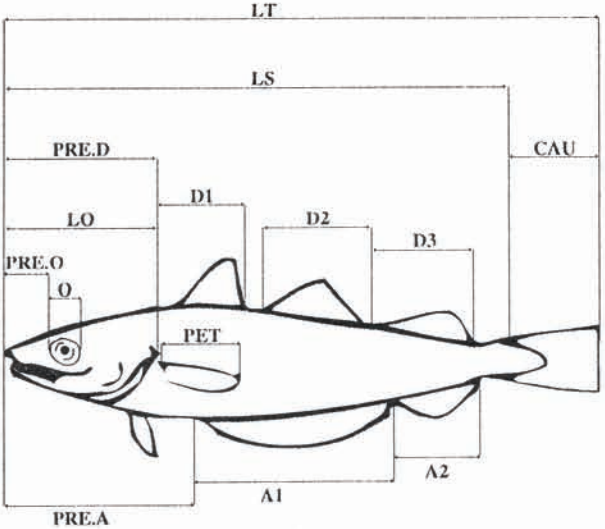

Fig. 1. - Metric measurements. LT = total length; LS = standard length; CAU = caudal length; PRE.D = predorsal length; D1 = first dorsal fin length; D2 = second dorsal fin length; D3 = third dorsal fin length; LO = head length, PRE.O = preorbital length; O = eye diameter; PET = pectoral fin length; PRE.A = preanal length; A1 = first anal fin length; A2 = second anal fin length.

RESULTS

Table I contains the statistical values relative to the variables of two groups of analysed samples (minimum, maximum, arithmetic mean, variance, T-test). The indices that distinguish the Adriatic samples from those from the Black Sea are LO, PET, O, NR2D, PRE.O and D2. It is noteworthy that some of these parameters are the same as those used to distinguish between the two subspecies in previous studies. In all the samples from the Black Sea the barbel was present and clearly visible (> 2 mm), independently of the size of the fish, while among the Adriatic samples the barbel was absent or microscopic.

Table I. - Statistical analysis.

		Adriatic				Black Sea				T - test * = 0.05 ** = 0.01
Variables		**min.**	**max.**	**mean**	**var.**	**min.**	**max.**	**mean**	**var.**	
CAU	**(%SL)**	7.18	12.33	9.9	1.58	7.56	15.38	9.28	3.98	
LO	**(%SL)**	24.88	28.46	26.82	0.97	26.92	29.55	28.89	1.42	**
PRE.O	**(%SL)**	8.74	12.83	10.31	0.61	9.61	11.81	10.89	0.41	*
PRE.D	**(%SL)**	26.95	33.57	30.58	2.33	29.13	32.8	30.69	1.36	
PRE.A	**(%SL)**	33.84	46.11	38.51	6.10	35.58	45.38	39.74	7.92	
O	**(%SL)**	5.00	8.33	6.14	0.45	6.25	8.40	7.23	0.38	**
D1	**(%SL)**	11.31	17.96	14.76	1.61	12.61	16.78	15.34	1.73	
D2	**(%SL)**	14.69	25.25	19.35	4.03	16.54	20.00	18.17	1.14	*
D3	**(%SL)**	13.33	19.66	16.49	2.81	15.38	20.16	17.41	2.49	
A1	**(%SL)**	25.97	33.57	30.32	5.17	27.2	36.13	30.61	5.87	
A2	**(%SL)**	13.7	24.48	17.03	4.08	13.95	19.69	17.92	2.44	
PET	**(%SL)**	14.84	16.85	15.85	0.38	15.89	19.69	17.54	1.72	**
NR1D	**n°**	10	16	13.91	2.08	13	16	14.29	0.53	
NR2D	**n°**	14	21	17.21	2.80	14	18	15.93	1.61	*
NR3D	**n°**	14	20	17.24	2.56	15	19	17	2.15	
NR1A	**n°**	22	29	25.64	4.16	23	32	26	8.00	
NR2A	**n°**	13	21	17.03	3.36	14	20	17.29	3.76	

The application of the PCA has made it possible to observe the differences between the populations. The first three axes explain 51.8% of the variability of the system (1st axis = 25.4%; 2nd axis = 13.9%; 3rd axis = 12.5%) and the coefficients of variability are listed in table II; for the first axis the highest value is for D2 followed by NR2D, NR3D, D3, for the second axis A1 is the highest followed by NR2D, A2, NR1D, for the third axis the order is A2, L0, PET.

Figures 2 and 3 show a discrete separation between two areas of the graph, characterizing the different disposition of the points relative to the sampling in the Adriatic and the Black Sea.

Table II. - Factorial coefficients of the variables (3 axes of the PCA).

Variables		**1° axis**	**2° axis**	**3° axis**
CAU	**%SL**	0.0068	-0.0684	-0.1912
LO	**%SL**	-0.2354	-0.0580	0.3116
PRE.O	**%SL**	-0.0817	-0.0217	0.0862
PRE.D	**%SL**	-0.0554	-0.0205	0.1646
PRE.A	**%SL**	-0.6631	-0.4428	-0.4174
O	**%SL**	-0.1424	-0.0712	0.1154
D1	**%SL**	-0.0010	-0.1836	0.0586
D2	**%SL**	0.4523	-0.0644	-0.1603
D3	**%SL**	0.1130	-0.3706	0.2414
A1	**%SL**	-0.3924	0.7063	-0.0773
A2	**%SL**	-0.1113	0.0424	0.6622
PET	**%SL**	-0.1917	-0.0675	0.2520
NR1D	**n°**	-0.0490	0.0175	0.1759
NR2D	**n°**	0.1862	0.2577	-0.1339
NR3D	**n°**	0.1314	-0.2067	0.0074

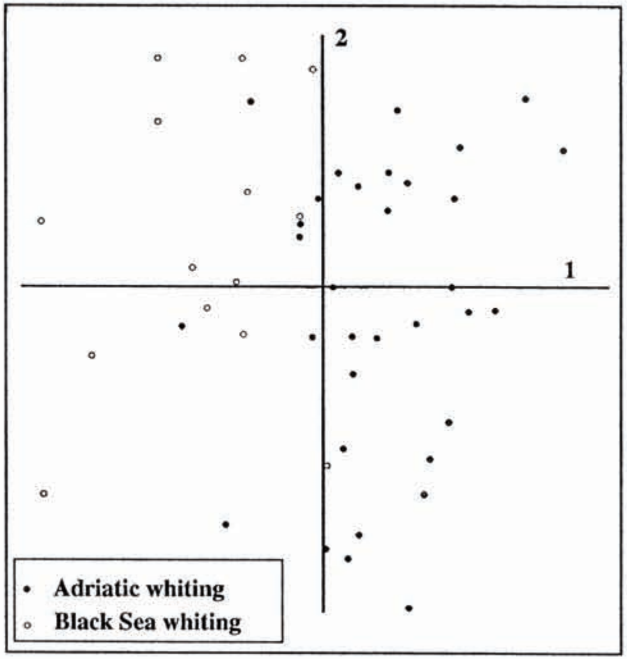

Fig. 2. - Principal components analysis: axes 1-2.

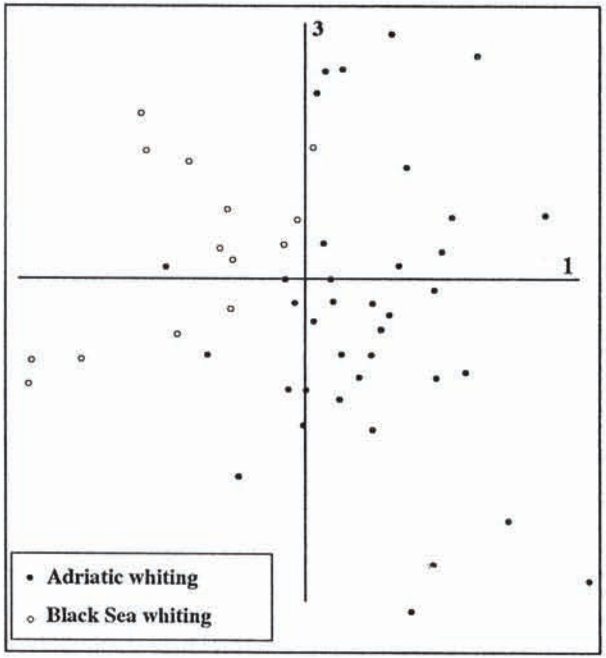

Fig. 3. - Principal components analysis: axes 1-3.

DISCUSSION

The analysis of some metric and meristic characteristics of samples of whiting collected in the Adriatic and the Black Sea suggest (with the limitations referring to the small number of specimens) the existence of a certain differentiation, at least at a morphological level, between the two populations; an higher number of data, together with genetic analysis techniques, should be useful to a best determination.

Such differentiation, if confirmed, is probably attributable to the spatial segregation of the two populations in the area considered; in fact, as previously mentioned, the whiting is mainly distributed, as far as the Mediterranean is concerned, in the Northern and Middle Adriatic, the Northern Aegean, the Sea of Marmara and the Black Sea. These basins have in common both salinities and average temperatures lower than those in other Mediterranean areas (Sarà, 1985) but are geographically separated by the Southern Adriatic and the Ionian seas, in which the parameters cited are higher. The two latter basins could therefore represent an ecological barrier to the exchanges between the whiting populations, so causing the segregation of the two stocks.

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